Out of Order and Super Scalar

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Section 8
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Agenda

• Complex Pipelines
  – Hazards

• Out of Order
  – ROB vs Issue Window
  – Speculative store buffer

• Superscalar
  – Renaming
  – Branch Prediction

• Lab 3
Complex Pipeline Hazards

• What are the types of data hazards?
  – Why do we care?
  – Example code?
  – Solutions?

• What else limits our throughput
  – Respecting program-order
  – Inherent ILP of program (max width of CFG)
Reorder Buffer

• Why?
  – cheat sheet so we don’t get caught

• What?
  – Tracking info on instructions decoded but not committed yet

• How?
Issue Window

• Why?
  – Can more efficiently use resources
    • Allocation times?

• What?
  – Tracking yet to be issued instructions

• How?
Rollback

• Why?
  – Branch mispredict
  – Exception

• What?
  – Mechanism to return to previous state

• How?
  – What do we want it to look like after rollback
  – Where is the info?
Speculative Memory

• Why?
  – Can’t rewrite to memory before commit

• What?
  – Speculative store buffer holds tags, and data

• How
  – Bypass to load if tags match
Superscalar

• Why?
  – ILP in code can be exploited

• What?
  – Fetch, decode, issue, execute, commit multiple instructions per cycle
    • At minimum issue and execute

• How?
  – Many mechanisms
Superscalar Register Renaming

• Why?
  – RAW hazards between consecutive instructions

• What?
  – Parallel read and write ports in rename table during decode

• How?
  – Compare destination and sources
Superscalar Fetch

• Why?
  – Need to feed the beast
    • Out of order machines only work well if they have lots of instructions to schedule

• What?
  – Tight next line prediction coupling with I$
  – Predict multiple branches per fetch packet

• How?
  – Many ways
Questions?
Lab3

• Experimenting with BOOM
• Directed portion should be straight forward data collection and inference
• Open-ended again split into hw/sw
  – HW+SW: Branch prediction
  – HW: Issue window policy
  – SW: Torture and Parameter introspection
• Chance to finally get chiseling if you want
Paper Handback